species make to live in are to a great extent formed of pellets of their excreta. In 1874 he watched carefully the process of constructing the tubes in several species of Amphipoda. *Microdeutopus grandimanus* (*M. minax*, Smith) was a particularly favourable subject for observation. When captured and placed in a small zoophyte trough with small branching algæ, the individuals almost always proceeded at once to construct a tube, and could very readily be observed under the microscope. A few slender branches of the alga were pulled toward each other by means of the antennæ and gnathopods, and fastened by threads of cement spun from branch to branch by the first and second pairs of peræopods. The branches were not usually at once brought near enough together to serve as the framework of the tube, but were gradually brought together by pulling them in and fastening them a little at a time, until they were brought into the proper position, where they were firmly held by means of a thick network of fine threads of cement spun from branch to branch. After the tube had assumed very nearly its completed form, it was still usually nothing but a transparent network of cement threads woven among the branches of the alga, though occasionally a branch of the alga was bitten off and added to the framework: but very soon the animal began to work bits of excrement and bits of alga into the net. In this case the pellets of excrement, as passed, were taken in the gnathopods and maxillipeds, and apparently also by the maxillæ and mandibles, and broken into minute fragments and worked through the web, upon the outside of which they seemed to adhere, partially by the viscosity of the cement threads, and partially by the tangle of threads over them. Excrement and bits of alga were thus worked into the wall of the tube until the whole animal was protected from view, while, during the whole process, the spinning of cement over the inside of the tube was kept up. When spinning the cement threads within the tube the animal was held in place on the ventral side by the second pair of gnathopods and the caudal appendages, the latter being curved beneath the anterior portion of the pleon, and on the dorsal side by the third, fourth, and fifth pairs of peræopods extended and turned up over the back, with the dactyli turned outward into the web. The spinning was done wholly with the first and second peræopods, the tips of which were touched from point to point over the inside of the skeleton tube in a way that recalled strongly the movements of the hands in playing upon a piano. The cement adhered at once at the points touched and spun out between them in uniform delicate threads. The threads seemed to harden very quickly after they were spun, and did not seem even from the first to adhere to the animal itself.

Death by Hanging.—Recent experiments regarding the nature of death by hanging or strangulation induce Prof. Tamasia to reject the view that the chief cause of such death is compression of the pneumogastric, causing paralysis of the heart (*Reale Ist. Lomb.*, fasc. xiii.). In the great majority of cases, he says, the proximate cause of death is the occlusion of the respiratory passages. The greater or lesser rapidity of the death depends on the degree of such occlusion. Compression of the pneumogastric and of the vessels of the neck may strengthen the efficacy of that direct cause, but, in the absence of the latter, it is insufficient to cause any instantaneous lethal phenomenon, as some have supposed.

Hæmoglobin in Echinoderms.—The presence of hæmoglobin in the aquiferous system of an Echinoderm (*Ophiactis urens*, one of the Ophiurida) has lately been demonstrated by M. Foottinger (Belgian Acad. *Bull.*, No. 5). The only branches of the metazoa in which it had not before been found were echinoderms and zoophytes. Simroth observed certain globules in the ambulacral canals of the former, but not observing live individuals, he missed the hæmoglobin, which may be observed if one of the arms of the living animal be broken; a drop of red colour appearing presently at the extremity. With the spectroscope the identity of the colouring matter with that of the blood of vertebrates can be easily proved. The hæmoglobin is connected with globules, of varying form and size. Most have a nucleus and are true cells. Along with these are free nuclei and small unnucleated corpuscles charged with hæmoglobin.

An Optical Property of the Cornea.—Prof. Fleischl of Vienna has recently examined fresh corneas in polarised light, and found that the corneal fibres became, under tension, doubly refractive, and then occasionally give phenomena similar to those occurring in starch granules (the theory of which has been examined by von Lang). With this condition also is connected the opacity of the cornea on rise of intraocular pressure.

Phosphoric Acid in the Urine of Cows.—It is generally supposed that the urine of herbivora does not contain phosphoric acid. M. Chevron, however, lately had occasion (*Bull. de l'Acad. Roy. de Belg.*, No. 8) to observe phosphates (a combination of potassico-magnesian phosphate with bimagnesic phosphate) in the urine of cows which had been receiving linseed oil-cake (1½ kil. per head daily), bran (1½ kil.), beet (25 kil.), and straw (7½ kil.), a diet which is rich in phosphoric acid (oil-cake and bran) and in potash (beet). The phosphoric acid diminished and disappeared when green clover or lucern was substituted for the beet. It appears from experiments made by Herr Bertram in Leipzig, in 1878, that lime has the property of eliminating phosphoric acid from the urine of herbivora, and M. Chevron points out that the green fodder specified undoubtedly imparted more lime than the beet did. He proposes further experiment, however, to determine exactly the cause of elimination of the acid

Rudimentary Coma in Godetia.—While investigating the development of the embryo sac in the different genera of Onagraceæ, writes Mr. John M. Coulter, editor of the *Botanical Gazette*, Indiana (vol. v. Nos. 8 and 9, p. 75), my attention was attracted to certain hair-like projections which appeared upon the forming ovule of Godetia (probably *G. grandiflora*). A careful examination showed them to be identical in structure with the forming hairs in the coma of Epilobium. They occurred almost exclusively at the chalazal end, one or two scattered ones being detected farther down upon the raphe. A study of the development of the coma of Epilobium shows that the first indication of it is a tuberculated appearance of the chalazal end. Presently these tubercles push out into elongating nucleated cells, which eventually develop into the long hairs of the coma. Now Godetia permanently retains this tuberculated margin at the upper end, but does not usually develop its coma any further. In the cases examined, however, the forming ovules (either in reminiscence or prophecy) stretched out their tubercles into incipient hairs. Tracing these ovules in their subsequent development, it was found that these hairs gradually disappeared until, when the ovules had become anatropous, there was no indication of them. As Godetia has been merged into Œnothera, many species of the latter were examined, to see if any such thing occurred in them; but no trace of such growth was detected. This would seem to indicate that if Godetia be not entitled to generic rank, it is at least that part of Œnothera which approaches Epilobium. A discrepancy must, however, be noticed here. In Epilobium the hairs of the coma do not begin to form until the ovule has become completely anatropous; but in the Godetia observed the incipient coma had all disappeared by the time the ovule had become anatropous, beginning to form before the nucleus is half covered by the coats. These hairs appeared in greatest size and abundance when the axis of the ovule was at right angles to its anatropous position.

PHYSICAL NOTES

A beautiful illustration of the laws of polarisation of light has lately been made by M. G. Govi. To understand it requires a somewhat careful explanation. Let a parallel beam of light be passed through a polariser, then through a thin slice of quartz cut perpendicularly to the optic axis, then through an analysing Nicol prism. It is seen, as is well known, to be coloured. This coloured light when passed into a spectroscope gives a spectrum marked by one or more dark bands, corresponding to the particular rays whose relative retardations in passing through the crystal slice have produced interference. These bands are not always in one place; they are displaced right or left (according to whether the crystal is a right-handed or a left-handed specimen) if either the analyser or the polariser be rotated. A slice of quartz about 4·3 millims. thick produces a single band. One of 8·6 millims. two bands at once in the visible spectrum, the number of bands being proportional to the thickness of the crystal. Now suppose a mechanical contrivance by which both the analyser and the spectrum can be rotated at the same velocity. A direct-vision prism attached to the front of the Nicol prism realises the optical portion of this combination. There will be seen on rotation a circular spectrum, having either red or violet at the centre and either violet or red at its outer circumference. Now since the dark band spoken of is displaced by a quantity proportional to the amount of rotation, interference will take place in this circular spectrum along points which form geometrically a spiral of Archimedes. The persistence of impressions on the retina will enable this dark spiral to be seen in its entirety,

provided the rotation be sufficiently rapid. If a thicker piece of quartz be used, giving two, three, or four dark bands, the rotation-spectrum will present a most beautiful appearance, being crossed by a two-branched, or three-branched, or four-branched spiral, the separate lines of which proceed from the centre to the circumference. The sense of these dark spirals will change with the sense of the impressed rotation. The effects are very striking.

SEVERAL ingenious contemporaries of ours on this side of the Atlantic have furnished the eager appetites of their readers with diagrams of Graham Bell's photophone, of which the most casual observer cannot fail to notice the utter want of resemblance to one another. More than one at least of these is *ben trovato*.

LIQUID OZONE has been obtained by MM. P. Hautefeuille and J. Chappuis, and is found to be of a beautiful blue colour. If a mixture of oxygen and ozone at a temperature of about $-23°$ or $-25°$ be subjected to a considerable pressure, the ozone liquefies and will remain liquid even though the pressure be reduced to 10 atmospheres. Experiments involving alterations of pressure must however be carefully made; for the ozone is liable to change into oxygen with a sudden evolution of heat, producing an increase of pressure with explosive violence. It is necessary to interpose a layer of sulphuric acid upon the top of the column of mercury by which the pressure is applied in the instrument, as ozone acts directly on the mercury.

HERR HANKEL has recently (*Wied. Ann.*, No. 8) endeavoured to prove the direct transformation of vibrations of radiant heat into electricity. He had formerly shown that rock crystal has thermoelectric polar axes in the direction of its secondary axes (the six successive poles being alternately positive and negative), and he supposes the ether within the crystal to be so arranged that under influence and with participation of the material molecules it is movable in circular paths round the secondary axes, and more easily movable in one direction than in the other. Thus all along a secondary axis the more easily occurring rotation has the same direction, but looked at from without, the direction is opposite at one end to what it is at the other, so giving the opposite modifications of electricity. When radiations from without strike along such an axis, those vibrations in them whose direction coincides with that of the easier rotation of the ether-molecule in the crystal should induce rotation of this along with the material molecule, and at the two ends of the secondary axis there should be electric tensions, with opposite electricity. Herr Hankel verified this by placing an insulated metallic ball connected with a gold-leaf electroscope in the middle of one edge of a rock crystal fixed with its principal axis vertical, while sunlight was thrown from the other side along the secondary axis terminating at the ball; then the arrangement was reversed. The electroscope indicated opposite electricities in the two cases. A gas-flame or a heated ball gave similar effects, which, moreover, were proved to be due to the dark heat rays (not to the luminous rays).

THE specific rotatory power of paraglobulin in blood serum is 47°·8 for yellow light; that of albumen, 57°·3. As these are the only albuminoid substances present in any considerable quantity, two determinations with the aid of the polaristrobometer suffice (as M. Fredericq has shown to the Belgian Academy) for ascertaining their relative proportions. The rotation produced by the whole liquid is first determined; then the paraglobulin is precipitated with $MgSO_4$, then redissolved in a volume of water equal to that of the original serum, and the rotation-number got from this is deducted from that got previously. Each of the numbers divided by that representing the specific rotatory power of the corresponding substance indicates the quantity of the substance in 100 cc.

IN a recent brief memoir to the *R. Accademia dei Lincei* (*Atti*, June, 1880), Dr. Bartoli describes an ingenious application of the Bunsen calorimeter to determination of the mechanical equivalent of heat. A given mass of mercury at zero temperature is subjected to a considerable pressure, exactly determined, and passed through a steel tube of so small internal diameter and such length that its velocity of outflow is virtually *nil*, and so the work equivalent to the kinetic energy of the mercury issuing from the tube becomes negligible in presence of the work consumed by friction between the mercury and the walls of the tube. This tube penetrates into a metallic cylinder situated within the reservoir of the Bunsen calorimeter. The quantity of ice melted in the calorimeter serves as measure of the heat developed by the work of efflux of mercury. It is stated that the numerical results are noteworthy for their agreement with the mean of former determinations, and still more for the narrow limits between which the extreme values arrived at are comprised.

EXPERIMENTS with regard to interpretation of the unequal reversal of magnesium lines in the green part of the solar spectrum are detailed by M. Fiévez in a recent paper to the Belgian Academy (*Bull.* No. 8). He first examined the influence of relative intensity of bright magnesium lines on their visibility by observing them separately and projecting them on the solar spectrum. Then he repeated the experiments of simplification of the spectrum by varying the intensity of the spark. Lastly, he studied the influence of greater or less dispersion and definition on the number and visibility of the lines, comparing prismatic with diffraction spectra. The experimental arrangements were mainly the same as in his recent researches on the spectra of hydrogen and nitrogen. The conclusion he arrives at is that the unequal reversal in question is due merely to a difference in the intensity of the bright lines, not to a dissociation of the metal.

M. BOUTY considers he has proved (*Journal de Phys.*, September) that in simple electrolysis the Peltier phenomenon is produced according to the same laws as at the surface of contact of two metals. It is a purely physical phenomenon without known relations with the heat of combination, or with the latent heat of solution, but connected by a precise law with the thermo-electric forces of corresponding couples. Chemical actions intervene in the production of one or other of the two inverse phenomena merely as disturbing causes, either altering the nature of the surfaces or producing a secondary liberation of heat. They may mask, more or less, the phenomenon on which they are superposed, but they do not produce it.

GEOGRAPHICAL NOTES

MR. LEIGH SMITH, during his Arctic cruise in his yacht *Eira*, has evidently done some very good work this summer. After cruising about the east coast of Greenland and in the neighbourhood of Spitzbergen, finding the ice-pack too dense and too far south to get far north without danger—although he reached 79° 40′ N. in 46° 50′ E., the farthest point yet reached in that direction—Franz-Josef Land was reached on August 14. Here much exploring work was done. Land was found stretching away west and north-west from that discovered by the Austrians. A fine harbour, called after the *Eira*, was found in 80° 5′ 25″ N., 48° 50′ E., and several excursions were made from this basis, among the numerous fjörds that pierce the mainland north and north-west. From the point named by the last Dutch expedition Barentz Hook, land was traced westwards some 110 miles, and from the extreme north-west point reached land was sighted forty miles further north-west. In the sea between were several large and small islands, all covered with glaciers and snow-fields, with bluff black headlands on the southern exposure, covered with vegetation. Several Arctic flowers were collected and brought home; a number of soundings and dredgings were made, yielding interesting results, and two bears which were caught have been sent to the Zoological Gardens. Evidently there is here a considerable archipelago, if not continuous stretch of land, giving some support to Petermann's theory that the Pole is probably surrounded by numerous islands. It is stated that Mr. Leigh Smith goes back next year; we trust he will reach Eira Harbour early, and be able to still further extend our knowledge of these new Arctic lands.

THE October number of *Petermann's Mittheilungen* contains several good papers. There is an interesting account of the progress of the Japanese trading station in Corea, which now contains about 2,000 Japanese inhabitants. Important information is given as to the results of Dr. O. Finsch's voyage in the Pacific. During a stay in the Sandwich Islands he made considerable additions to our knowledge of their natural history; thence he went to Jabut (Bonham) in the south of the Marshall Group, where his collections and observations in all directions were numerous and of great value. Thence he proceeded to the Gilbert or Kingsmill Group, and afterwards to the Carolines. Some idea of the results so far may be obtained from the fact that he has sent to Europe something like thirty boxes of collections; the materials collected in ten months embrace 70 mammals, 180 birds, 800 reptiles, 1,200 fishes, 15,000 molluscs, 800 crustaceans, 400 spiders, 1,400 insects, and about 150 other animals, besides 700 plants, and two boxes of minerals. In anthropology there are 50 skulls and 55 casts of faces, representing the peoples